

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property  
Organization  
International Bureau



(43) International Publication Date  
4 March 2004 (04.03.2004)

PCT

(10) International Publication Number  
**WO 2004/017861 A2**

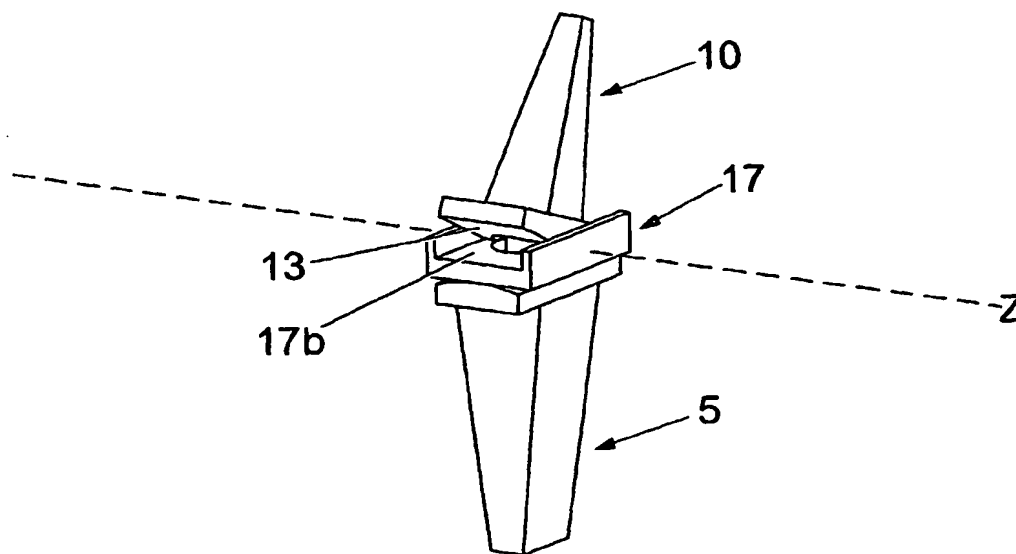
- (51) International Patent Classification<sup>7</sup>: **A61F 2/00**
- (21) International Application Number:  
PCT/GB2003/003763
- (22) International Filing Date: 26 August 2003 (26.08.2003)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:  
0219758.0 24 August 2002 (24.08.2002) GB
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- (81) Designated States (*national*): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.
- (84) Designated States (*regional*): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

## Declarations under Rule 4.17:

— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii)) for the following designations AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE,*

[Continued on next page]

(54) Title: DEVICE



(57) Abstract: An implantable replacement joint is described. The replacement joint includes first and second components having respective bores, and a flexible member within a cavity formed by the respective bores.



KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, UZ, VC, VN, YU, ZA, ZM, ZW, ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG)

— of inventorship (Rule 4.17(iv)) for US only

**Published:**

— without international search report and to be republished upon receipt of that report

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

1     "Device"

2

3     This invention relates to an implantable replacement  
4     joint, and typically, but not exclusively to a body-  
5     implantable replacement joint to replace worn or  
6     damaged joints in a body.

7

8     Joint replacement is a well established practice for  
9     treating patients suffering from diseases such as  
10    inflammatory arthritis or osteoarthritis. These  
11    conditions can result in considerable pain, loss of  
12    function, deformity and loss of quality of life.

13    The most common types of artificial implant joints  
14    are used to replace worn or damaged hip joints, and  
15    typically consist of a ball and socket arrangement  
16    attached to bones at respective sides of the joint,  
17    or flexible silicon-based bridges such as the  
18    Swanson device, which is used for smaller joints  
19    such as the wrist or fingers. Loosening,  
20    dislocation tearing and fracture have been all  
21    reported for existing implants.

22

1 According to the present invention there is provided  
2 an implantable replacement joint comprising a first  
3 component for attachment to a first bone portion; a  
4 second component for attachment to a second bone  
5 portion; and a flexible component extending between  
6 the first and second components; wherein each of the  
7 first and second components has a respective bore  
8 and the flexible component is received within a  
9 cavity formed by the bores of the first and second  
10 components; and wherein the flexible component is  
11 freely-floating within the cavity.

12

13 The first bone portion is typically located on one  
14 side of a joint, and the second bone portion is  
15 typically located on the other side of the joint.

16

17 The first and second components are typically  
18 adapted to be anchored within cavities in the  
19 respective first and second bone portions on  
20 opposing sides of the joint to be replaced. The  
21 first and second components can typically be  
22 anchored in place using friction, and in such  
23 embodiments can be shaped to be an interference fit  
24 within a cavity of the first and second bone  
25 portions. The cavity can be naturally occurring,  
26 e.g. the intramedullary canal, or can be created  
27 within a bone or group of bones to receive the first  
28 and second components, as required. In alternative  
29 embodiments, the first and second components can be  
30 anchored into the respective bone portions using  
31 adhesives, cement, grout, screw threads, or fixing  
32 devices such as screws, nails or expansion devices

1     etc.

2

3     In certain embodiments the first and second  
4     components have formations on their outer surfaces  
5     in order to key into the inner surfaces of the  
6     cavities in the first and second bone portions. The  
7     formations on the outer surfaces of the first and  
8     second portions can typically be screw threads,  
9     annular or semi-annular ridges or simple protrusions  
10    or expansion fins on the outer surfaces.

11

12    Typically the flexible component is elongate. In  
13    preferred embodiments, each of the first and second  
14    components has an elongate stem with a central bore  
15    extending along the stem to receive a part, e.g. one  
16    end, of the flexible component. In such  
17    embodiments, the flexible component can thus be  
18    substantially contained within a cavity formed by  
19    the central bores of the first and second  
20    components. Typically the cavity is longer than the  
21    flexible component, so that the flexible component  
22    can move axially within the cavity. Typically the  
23    bores of the first and second components are wider  
24    than the flexible component so that the flexible  
25    component is a loose fit within the cavity. The  
26    relative dimensions of the flexible component and  
27    the first and second components are preferably such  
28    that even if the first and second components are  
29    pushed together to close any gap between the central  
30    bores, the flexible component will not be compressed  
31    within the cavity by the first and second  
32    components.

1 In especially preferred embodiments, the first and  
2 second components have bearing surfaces that  
3 articulate against one another when the device is  
4 made up. Typically the central bores and the  
5 flexible component extend through the bearing  
6 surfaces. The bearing surfaces can be arcuate and  
7 can be adapted to promote pivotal movements of the  
8 first and second components relative to one another.  
9 Preferably bearing surfaces promote particular  
10 pivotal movements e.g. in a particular plane.  
11 Typically the arcuate portions of the respective  
12 bearing surfaces on the first and second components  
13 are arranged on opposite axes, so that, for example,  
14 the bearing surface on the first component can be  
15 convex along an x-axis, and the bearing surface on  
16 the second component can be convex along a y-axis  
17 intersecting the x-axis. This arrangement can be  
18 extremely useful in promoting pivotal movements in  
19 more than one plane, allowing the replacement joint  
20 a number of degrees of freedom of movement, while  
21 controlling the location of the pivot axis on the  
22 device. However, it is envisaged that simple  
23 embodiments of the invention can be created with  
24 only one degree of freedom of movement, and without  
25 curved bearing surfaces.

26

27 Typically the first and second components are made  
28 from a relatively hard plastics material or carbon  
29 fibre composites, and preferably from one that is  
30 not biodegradable. Suitable materials for the first  
31 and second components include stainless steel,  
32 alloys such as cobalt chrome or titanium alloy,

1 polyethylene or other plastics materials, or  
2 ceramics or carbon fibre composites. It can be  
3 advantageous to use materials for the first and  
4 second components that have a similar modulus to  
5 bone itself, and plastics materials are particularly  
6 useful in this respect.

7  
8 The flexible component can be made from a resilient  
9 material such as rubber, and in preferred  
10 embodiments of the invention, the flexible component  
11 does have some resilience. The flexible component  
12 is typically formed from a relatively softer  
13 material than the first and second components. The  
14 flexible component can be made from e.g. silicone or  
15 polyurethane and can preferably have a flexibility  
16 that is intrinsic to the material used, although  
17 other forms of flexible component can be used where  
18 the flexibility is derived from e.g. a hinge  
19 inserted into a rigid material. The material chosen  
20 for the flexible portion is typically different from  
21 the material chosen for the first and second  
22 portions.

23  
24 The flexible portion can typically have a convoluted  
25 hinge made up from a convoluted or folded section of  
26 the material.

27  
28 In some embodiments of the invention, a bearing  
29 plate can be provided between the bearing surfaces  
30 of the first and second components. The bearing  
31 plate can typically be of a different material from  
32 the first and second components (for example, where

1 the first and second portions are made from plastics  
2 material, the bearing plate can usefully be made  
3 from a metal), in order to reduce wear caused by the  
4 bearing surfaces of the first and second components  
5 rubbing against one another.

6

7 Embodiments including a bearing plate are especially  
8 advantageous where the joint being replaced has to  
9 bear significant loads e.g. wrist joints. In such  
10 cases, the first and second components are typically  
11 formed from a plastics material and the bearing  
12 plate 17 is preferably formed from a metal (e.g.  
13 stainless steel or titanium) or ceramics, which  
14 provide a low-friction interface between the bearing  
15 plate 17 and each of the first and second  
16 components. Replacement joints which do not have to  
17 bear such significant loads, such as replacement  
18 finger joints may be formed with or without bearing  
19 plate 17.

20

21 The bearing plate can have arcuate surfaces if  
22 desired, but in simple embodiments has generally  
23 flat faces. The bearing plate can extend the range  
24 of movement that is possible between the first and  
25 second components, by introducing an additional  
26 pivot point, so that each of the first and second  
27 components pivots on opposite faces of the bearing  
28 plate. The bearing plate can be formed with legs,  
29 extensions or prominent edges that can generally  
30 attach the bearing plate to one of the first and  
31 second components. The bearing plate could also be  
32 formed of plastics material, ceramics or other



1     suitable materials. Where the first and second  
2     components are formed from ceramics materials, the  
3     bearing plate can comprise a plastics material so as  
4     to provide an interface of different materials at  
5     the bearing surfaces.

6  
7     The replacement joint of the invention is preferably  
8     a wrist joint, but can also be used in any joint,  
9     particularly fingers, toes, knees and elbows. Is  
10    particularly useful to replace worn or damaged  
11    joints where more than two degrees of freedom is  
12    required, such as rotation of the first and second  
13    components in addition to flexion/extension and  
14    medial/lateral deviation.

15  
16    In especially preferred embodiments of the  
17    invention, the pivot axis around which the first and  
18    second components move relative to one another is  
19    typically movable relative to the device, and this  
20    is typically achieved by the ability of the flexible  
21    component to move within the bores of the first and  
22    second components, thereby creating a "sloppy hinge"  
23    between the first and second components. This  
24    permits the first and second components to move  
25    axially relative to one another while moving in  
26    relative rotation and flexion/extension or in  
27    medial/lateral directions. Indeed, the ability to  
28    move axially while rotating, deviating laterally,  
29    and flexing or extending enables the replacement  
30    joint to move in a similar fashion to the natural  
31    joint it is replacing. This reduces strain on the  
32    anchoring points between the bone portions and the

1 first and second components, and reduces pull-out  
2 failures or bone wear at the interfaces.

3

4 An embodiment of the present invention will now be  
5 described by way of example, and with reference to  
6 the accompanying drawings, in which;

7

8 Fig 1 is a side view of a body implantable  
9 device;

10 Fig 2 is a front sectional view through the  
11 device of Fig 1;

12 Fig 3 is a side view of a first component of  
13 the fig 1 device;

14 Fig 4 is a front sectional view through the fig  
15 3 component;

16 Fig 5 is a front view of a second component of  
17 the Fig 1 device;

18 Fig 6 is a side sectional view through the fig  
19 5 component;

20 Fig 7 is a side view of a bearing plate used in  
21 the Fig 1 device;

22 Fig 8 is a plan view of the bearing plate;

23 Fig 9 is a side view of a flexible component of  
24 the Fig 1 device;

25 Fig 10 is a perspective view of the Fig 1  
26 device;

27 Fig 11 is a perspective view of the Fig 1  
28 device in flexion/extension;

29 Fig 12 is a side view of the Fig 1 device in  
30 flexion/extension;

31 Fig 13 is a perspective view of the Fig 1  
32 device showing lateral deviation;

1           Fig 14 is a side view of the Fig 1 device  
2           showing lateral deviation;  
3           Fig 15 is a front view of the Fig 1 device  
4           showing lateral deviation;  
5           Fig 16 is a perspective view of the Fig 1  
6           device showing relative rotation of the two  
7           components;  
8           Fig 17 is a side view of the Fig 1 device  
9           showing relative rotation of the two  
10          components;  
11          Fig 18 is a front sectional view of an  
12          alternative embodiment of the invention; and  
13          Fig 19 is a front sectional view of a further  
14          alternative embodiment of the invention.

15  
16       Referring now to the drawings, a body implantable  
17       device designed for use as the replacement wrist  
18       joint comprises a first component 5 and a second  
19       component 10. The first component 5 is dimensioned  
20       and adapted to be implanted within the distal end of  
21       the intramedullary canal of the radius, and the  
22       second component 10 is intended and adapted to be  
23       implanted into a bore created in the proximal part  
24       of the carpus and/or metacarpals. Each of the first  
25       and second components 5,10 can have external  
26       protrusions such as ridges or screw-threads (not  
27       shown) to enhance retention of the component within  
28       the bone portion into which it is implanted. In  
29       this embodiment, each of the first and second  
30       components 5,10 is sized and adapted to fit within  
31       either the intramedullary canal of the radius or the  
32       bore created in the carpus and/or metacarpals and to

1 form an interference fit within that cavity, so that  
2 they can be retained therein merely by friction  
3 between the outer surface of the components 5,10,  
4 and the inner surface of the cavity in the bone(s).  
5

6 With reference to fig 3 and fig 4, the first  
7 component 5 comprises a tapered stem 6 adapted to  
8 fit within the distal intramedullary canal of the  
9 radius, and a head 7 located on top of the stem 6.  
10 The head 7 has laterally extending arms and has a  
11 distal convex bearing surface 8 that is curved from  
12 the front of the first component 5 to the back. The  
13 radius of curvature of the surface 8 is  
14 approximately 16mm. The first component 5 has a  
15 blind-ended bore 9 extending axially through the  
16 stem 6, and presenting an aperture through the upper  
17 surface 8 of the head 7.  
18

19 The first and second components are made from ultra-  
20 high molecular weight polyethylene.  
21

22 With reference to Figs. 5 and 6 the second component  
23 10 also has a tapered stem 11, and a head 12, again  
24 with laterally extending arms, and a proximal  
25 bearing surface 13. The proximal bearing surface 13  
26 of the head 12 is also convex, but is curved from  
27 one side of the second component 10 to the other  
28 side. The radius of curvature of the bearing face  
29 13 is approximately 65mm. The second component 10  
30 has a blind-ended bore 14 extending axially through  
31 the stem 11, and presenting an aperture through the  
32 upper surface 13 of the head 12.

1 A flexible rod 15 of silicone as shown in fig 9 has  
2 a central cylindrical portion and tapered ends that  
3 are adapted to be received within the blind ended  
4 bores 9, 14 of the first and second components 5,10  
5 respectively. The length of the flexible rod is  
6 typically slightly less than the combined lengths of  
7 the blind ended bores 9, 14, so that when the device  
8 is assembled with the first and second components  
9 5,10 placed head-to-head, with the bores 9, 14  
10 aligned and the arms on the respective heads  
11 arranged parallel to one another, the flexible rod  
12 15 can move axially within the cavity formed by the  
13 two bores 9, 14.

14  
15 With reference to Figs. 7 and 8, a bearing plate 17  
16 formed of stainless steel is typically provided  
17 between the bearing surfaces 8, 13 of the heads  
18 7,12, and typically has an aperture 18 to allow  
19 passage of the flexible rod 15 through the bearing  
20 plate 17. The aperture 18 is aligned with the bores  
21 9,14 when the device is assembled. In this  
22 embodiment, the device is made up such that the  
23 bearing surface 8 of the first component 5  
24 articulates against one surface 17a of the bearing  
25 plate 17, while the bearing surface 13 of the second  
26 component 10 articulates against the opposite  
27 surface 17b of the bearing plate 17. The bearing  
28 plate 17 typically has arms extending from the  
29 surface 17b plate to engage the side walls of the  
30 head 12 of the second portion 10. It will be  
31 appreciated that embodiments of the invention can  
32 function satisfactorily without a bearing plate 17,

1 and that bearing plates can be used without side  
2 walls.

3  
4 Turning now to Figs. 10 to 17, the device is shown  
5 at rest in fig 10, with the two components 5,10 in  
6 axial alignment with one another with the bearing  
7 plate 17 interposed. In this configuration, the  
8 flexible rod 15 is not bent or energised in any way  
9 and is held within the cavity formed by the bores 9,  
10 14. Figs 11 and 12 show the device in flexion, with  
11 the second component 10 pivoting with respect to the  
12 first component 5 around the y-axis shown in fig 10.  
13 Notice that the bearing plate 17 moves with the  
14 second portion 10 relative to the first portion  
15 5, and that the bearing surface 8 of the head 7 of  
16 the first portion 5 articulates against the face 17a  
17 of the bearing plate 17. The front to back  
18 curvature of the bearing surface 8 promotes a smooth  
19 articulation about the y-axis. The ends of the  
20 flexible rod 15 remain within the bores 9, 14, and  
21 the central portion of the rod 15 bends to  
22 accommodate and control the flexion. Since the rod  
23 15 can move axially within the cavity formed by the  
24 bores 9, 14, the pivot axis formed in the central  
25 portion of the rod 15 can move axially with respect  
26 to the first and second portions 5,10 as the device  
27 flexes, thereby allowing a greater range of movement  
28 of the joint. Also, since the flexible rod 15 can  
29 move within the cavity formed by the bores 9, 14,  
30 the two portions 5,10 can extend relative to one  
31 another along the x-axis, while undergoing flexion,  
32 extension, medial/lateral deviation and/or rotation.

1 Figs 13, 14 and 15 show the joint moving in  
2 medial/lateral deviation around the z-axis of fig  
3 10, i.e. as if moving in radio-ulnar deviation when  
4 in place in the body. Notice that during lateral  
5 deviation around the z-axis, the bearing plate 17  
6 remains with the first portion 5, and the bearing  
7 surface 13 of the head 12 of the second portion 10  
8 articulates against the surface 17b of the plate 17.  
9 In pure lateral deviation, with no movement around  
10 the y-axis, the pivotal movement of the plate 17  
11 relative to the first portion 5 is negligible, and  
12 the lateral movement of the first portion 10 is  
13 constrained by the head 12 moving within the  
14 confines of the arms of the bearing plate 17. In  
15 certain circumstances, the plate 17 can move  
16 relative to the first portion 5, for example, when  
17 the flexible rod 15 moves axially to allow the  
18 extension of the device.

19  
20 Figs. 16 and 17 show relative rotational movement of  
21 the two portions 5,10 around the x-axis. Notice  
22 that the arms of the bearing plate 17 keep the plate  
23 17 stationary with respect to the second portion 10,  
24 and the two portions pivot around the axis of the  
25 flexible rod 15 held straight within the central  
26 cavity formed by the bores 9, 14.

27  
28 Clearly it is possible for the joint to carry out  
29 more complex combination movements involving a  
30 combination of rotation, medial/lateral deviation,  
31 and extension/flexion, in any combination. It is  
32 also possible for axial separation of the two

1 portions to occur during any such movement.

2

3 Modifications and improvements can be incorporated  
4 without departing from the scope of the invention.  
5 For example, the flexible member does not need to  
6 have the tapered form shown in Figs 2 and 9; instead  
7 the flexible member could be an un-tapered cylinder  
8 or a coil spring. Fig 18 shows an alternative  
9 embodiment, having a first component 105, a second  
10 component 110, a flexible member 115 and a bearing  
11 plate 117. Like the Fig 1 embodiment, each of the  
12 first and second components 105, 110 and bearing  
13 plate 117 have a respective internal bore though  
14 which flexible member 115 extends. Both ends of the  
15 bore of flexible member 115 are chamfered, as are  
16 the mouths of the bores of the first and second  
17 components 105, 110; this is advantageous, as it  
18 means there are no sharp edges which could abrade  
19 and damage the flexible member 115.

20

21 The cavity formed by the bores in the first and  
22 second components 105, 110 is longer and wider than  
23 flexible member 115, providing clearance between  
24 flexible member 115 and the cavity in both axial and  
25 lateral directions. As flexible member 115 is not  
26 fixed to either of the first or second components  
27 105, 110, flexible member 115 can move both axially,  
28 laterally and rotationally within the cavity; the  
29 flexible member thus has three degrees of freedom of  
30 movement.

31



1 Fig 19 shows a further embodiment of the invention  
2 which is very similar to the Fig 18 embodiment and  
3 like components have similar reference numbers,  
4 which are prefixed by "2". The bores in the first  
5 and second components 205, 210 increase in width  
6 towards the respective bore mouths at a greater rate  
7 than the increase in diameter of the flexible member  
8 215 due to its taper. This provides a greater  
9 clearance between flexible member 115 and the bores  
10 at the bore mouths compared to the bore ends.  
11

12 The Fig 19 embodiment has the advantage that  
13 stresses on the flexible member 215 are further  
14 reduced due to the relatively large clearance at the  
15 mouths of the bores in a first and second components  
16 205, 210 and a correspondingly wide bore in flexible  
17 member 215.  
18

19 It should be noted that the Fig 18 and Fig 19  
20 embodiments are not necessarily drawn to scale.  
21

22 Fig 20 shows a further embodiment of the invention,  
23 which is similar to the Fig 18 and 19 embodiments;  
24 like parts have similar reference numerals, prefixed  
25 with "3". In this embodiment, the lateral clearance  
26 between flexible member 115 and the cavity formed by  
27 the bores in the first and second components 305,  
28 310 is relatively small at the inner ends of each  
29 bore (i.e. flexible member 115 is a close lateral  
30 fit within the cavity at each end), but towards the  
31 bore mouths the diameter of each bore increases at a  
32 greater rate than the diameter of flexible member

1 315 to leave a wider lateral clearance with flexible  
2 member 115 at the bore mouths. The rate of change  
3 in width of each bore increases towards the bore  
4 mouth, so that the bore mouth is flared like the  
5 bell of a trumpet. In some embodiments, the flare  
6 at the bore mouth can be even more pronounced than  
7 shown in Fig 20, with the flaring of the bore  
8 starting even further from the bore mouth. The  
9 flaring of each bore is smooth, so that the bore  
10 mouth does not have any sharp corners which could  
11 otherwise abrade and damage flexible member 315.  
12 Like the Fig 18 and 19 embodiments, the bore in  
13 bearing plate 317 is also chamfered so that there  
14 are no sharp corners here either.

15

16 The Fig 20 embodiment provides the advantage that  
17 the close fit between flexible member 315 at the  
18 bore ends prevents the first and second components  
19 305, 310 from dislocating from each other, whilst  
20 the wider fit at the bore mouths helps prevent  
21 excessive wear on flexible member 315.

22

23

1     Claims

2

3     1.    An implantable replacement joint comprising a  
4     first component for attachment to a first bone  
5     portion; a second component for attachment to a  
6     second bone portion; and a flexible component  
7     extending between the first and second components;  
8     wherein each of the first and second components has  
9     a respective bore and the flexible component is  
10    received within a cavity formed by the bores of the  
11    first and second components; and wherein the  
12    flexible component is freely-floating within the  
13    cavity.

14

15    2.    A replacement joint as claimed in claim 1,  
16    wherein the first and second bone components are  
17    adapted to engage first and second bone portions  
18    located on opposite sides of a joint.

19

20    3.    A replacement joint as claimed in claim 1 or  
21    claim 2, adapted to replace a joint selected from  
22    the group consisting of wrists, fingers, toes, knees  
23    and elbows.

24

25    4.    A replacement joint as claimed in any preceding  
26    claim, wherein the first and second components are  
27    adapted to be anchored within cavities in the  
28    respective first and second bone portions.

29

30    5.    A replacement joint as claimed in claim 4,  
31    wherein the first and second components are shaped  
32    to be an interference fit within the respective

1 first and second bone portions.

2

3 6. A replacement joint as claimed in claim 4 or  
4 claim 5, wherein the first and second components  
5 have formations on their outer surfaces to engage  
6 the inner surfaces of the cavities in the first and  
7 second bone portions.

8

9 7. A replacement joint as claimed in claim 6,  
10 wherein the formations on the outer surfaces of the  
11 first and second portions are screw threads, annular  
12 or semi-annular ridges or expansion fins.

13

14 8. A replacement joint as claimed in any preceding  
15 claim, wherein the cavity formed by the bores in the  
16 first and second components is longer than the  
17 flexible component so that the flexible member can  
18 move axially within the cavity.

19

20 9. A replacement joint as claimed in any preceding  
21 claim, wherein the cavity formed by the bores in the  
22 first and second components is wider than the  
23 flexible component so that the flexible component  
24 can move laterally within the cavity.

25

26 10. A replacement joint as claimed in any preceding  
27 claim, wherein the first and second components have  
28 bearing surfaces that articulate against one another  
29 when the device is made up.

30

31 11. A replacement joint as claimed in claim 10,  
32 wherein the flexible component and the bores in the

1 first and second components extend through the  
2 bearing surfaces.

3

4 12. A replacement joint as claimed in claim 10 or  
5 claim 11, wherein the bearing surfaces are arcuate  
6 to promote pivotal movements of the first and second  
7 components relative to one another.

8

9 13. A replacement joint as claimed in claim 12,  
10 wherein the bearing surface of the first component  
11 is convex along a first axis and the bearing surface  
12 of the second component is convex along a second  
13 axis, the first and second axes being mutually  
14 perpendicular.

15

16 14. A replacement joint as claimed in any preceding  
17 claim, wherein the first component is pivotable  
18 relative to the second component around at least one  
19 axis.

20

21 15. A replacement joint as claimed in claim 14,  
22 wherein the at least one pivot axis is movable  
23 relative to the replacement joint.

24

25 16. A replacement joint as claimed in any preceding  
26 claim, wherein the first component is pivotable  
27 relative to the second component around more than  
28 one axis.

29

30 17. A replacement joint as claimed in claim 16,  
31 wherein the first and second components are  
32 pivotable relative to each other around two

1 perpendicular axes.

2

3 18. A replacement joint as claimed in any preceding  
4 claim, wherein the first and second components are  
5 made from a relatively harder material than the  
6 flexible member.

7

8 19. A replacement joint as claimed in any preceding  
9 claim, wherein the first and second components are  
10 made from a material selected from the group  
11 comprising stainless steel, metal alloys, plastics  
12 materials, ceramics and carbon fibre composites.

13

14 20. A replacement joint as claimed in any preceding  
15 claim, wherein the flexible component is resilient.

16

17 21. A replacement joint as claimed in any preceding  
18 claim, wherein the flexible component comprises a  
19 material having inherent flexibility.

20

21 22. A replacement joint as claimed in claim 21,  
22 wherein the flexible component is made from silicone  
23 or polyurethane.

24

25 23. A replacement joint as claimed in any preceding  
26 claim, wherein the flexible portion has a hinge.

27

28 24. A replacement joint as claimed in any preceding  
29 claim, wherein a bearing plate is provided between  
30 the bearing surfaces of the first and second  
31 components.

32

1     25. A replacement joint as claimed in claim 24,  
2     wherein the bearing plate is formed of metal or  
3     ceramics.

4  
5     26. A replacement joint as claimed in claim 24 or  
6     claim 25, wherein the bearing plate is of a  
7     different material from the first and second  
8     components.

9  
10    27. A replacement joint as claimed in any of claims  
11    24 to 26, wherein the bearing plate has arcuate  
12    surfaces.

13  
14    28. A replacement joint as claimed in any of claims  
15    24 to 27, wherein the bearing plate has two pivot  
16    points, and the first and second components are  
17    adapted to pivot on opposite faces of the bearing  
18    plate.

19  
20    29. A replacement joint as claimed in any of claims  
21    24 to 28, wherein the bearing plate has extensions  
22    that limit the movement of at least one of the first  
23    component and the second component relative to the  
24    bearing plate.

25  
26    30. A replacement joint as claimed in any preceding  
27    claim, wherein the clearance between the flexible  
28    component and the bores in the first and second  
29    components increases towards the mouths of the  
30    bores.

31  
32    31. A replacement joint as claimed in any preceding

1 claim, wherein the flexible component is free to  
2 move axially, laterally and rotationally within the  
3 cavity formed by the bores of the first and second  
4 components.

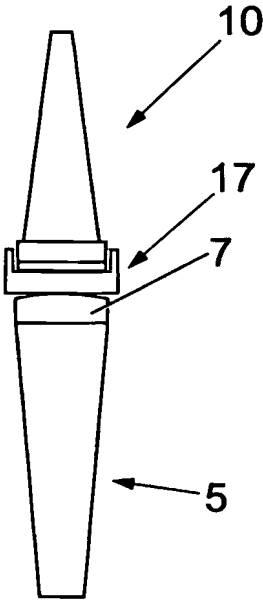
5

6 32. A replacement joint as claimed in any preceding  
7 claim, wherein the spacing between the bores of the  
8 first and second components and the flexible  
9 component is smaller around the ends of the flexible  
10 component than the corresponding spacing between the  
11 bore mouths and the middle of the flexible  
12 component.

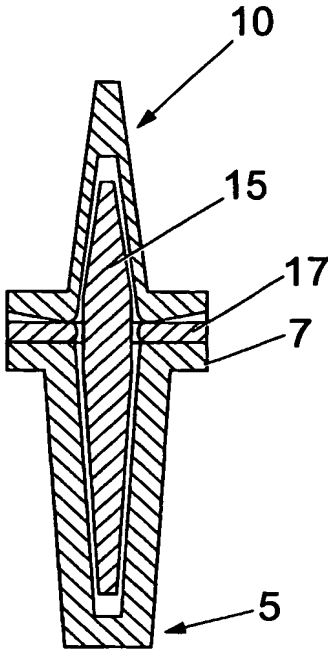
13

14 33. A replacement joint as claimed in claim 32,  
15 wherein the bores of the first and second components  
16 flare outwardly towards the bore mouths.





*Fig. 1*



*Fig. 2*

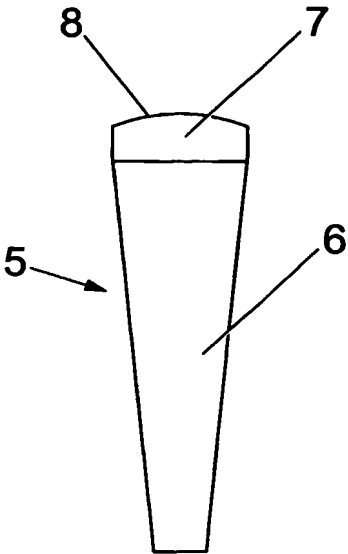


Fig. 3

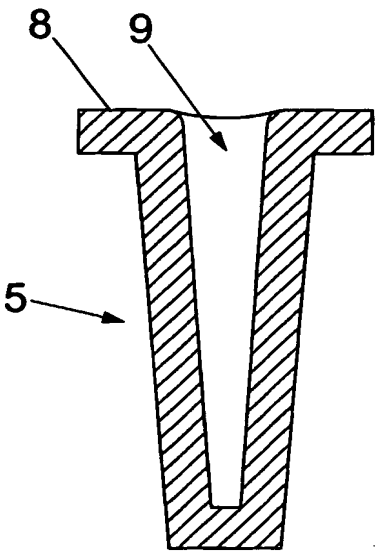
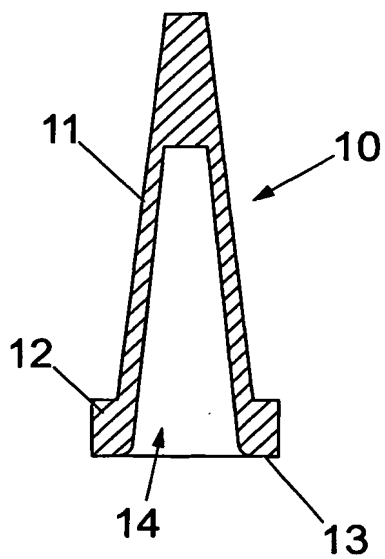
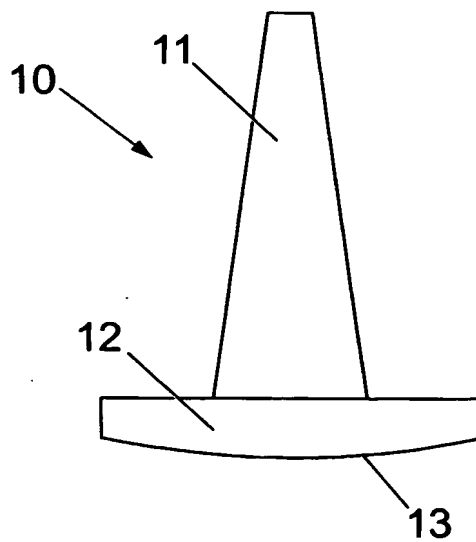


Fig. 4

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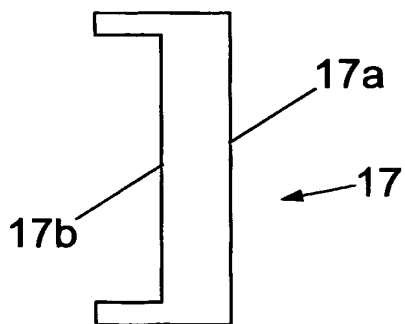


*Fig. 6*

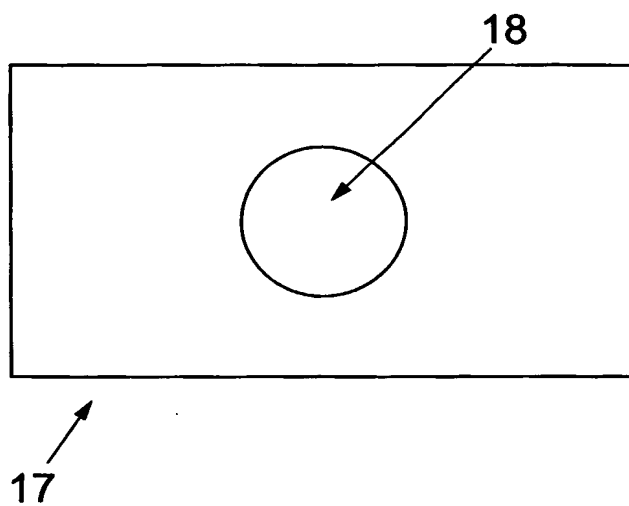


*Fig. 5*

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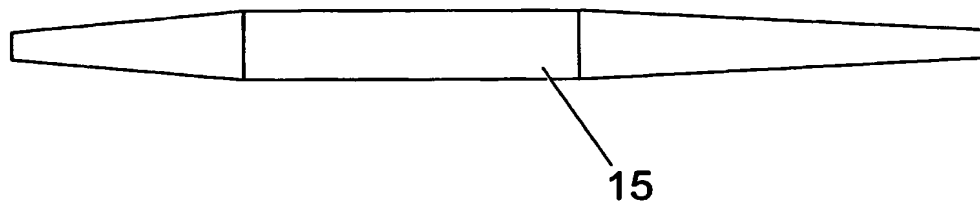


*Fig. 7*



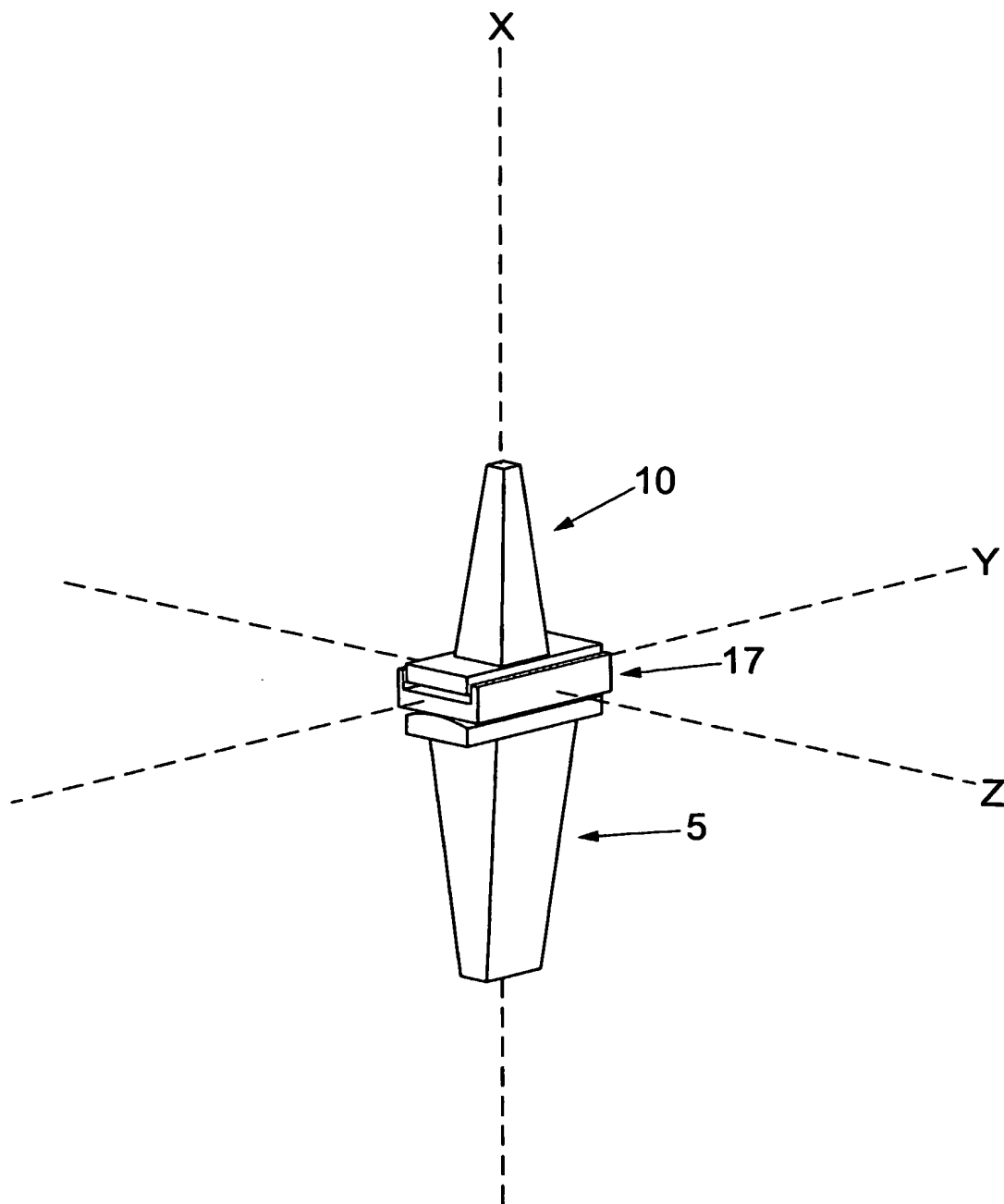
*Fig. 8*

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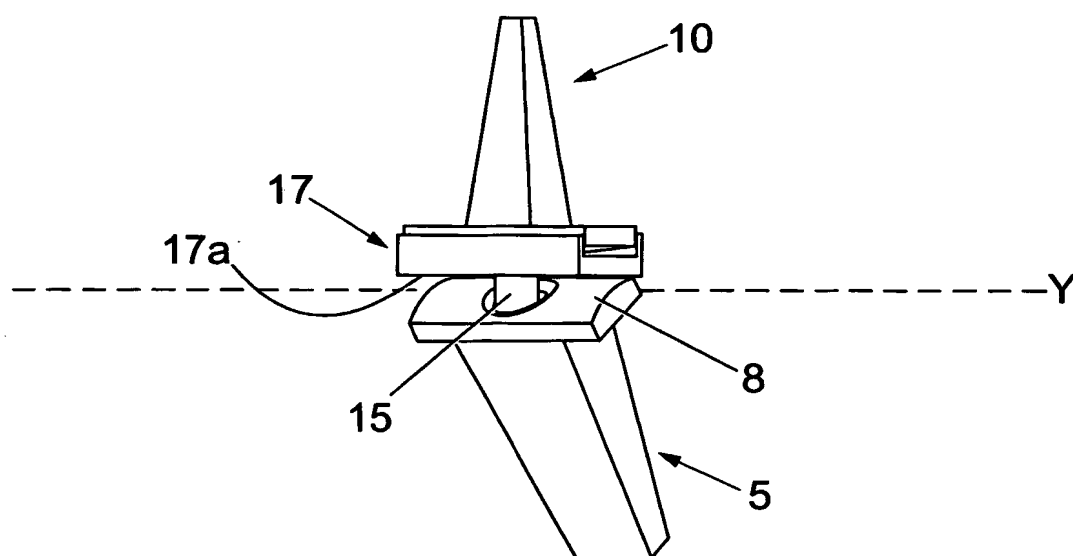
*Fig. 9*

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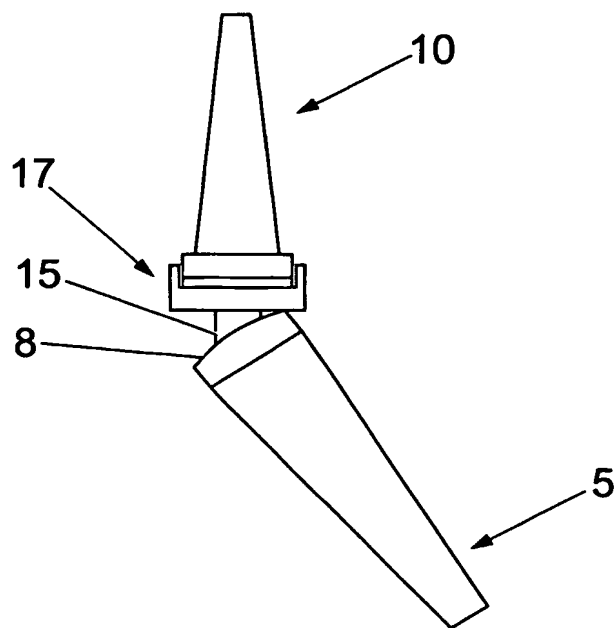


*Fig. 10*

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*Fig. 11*

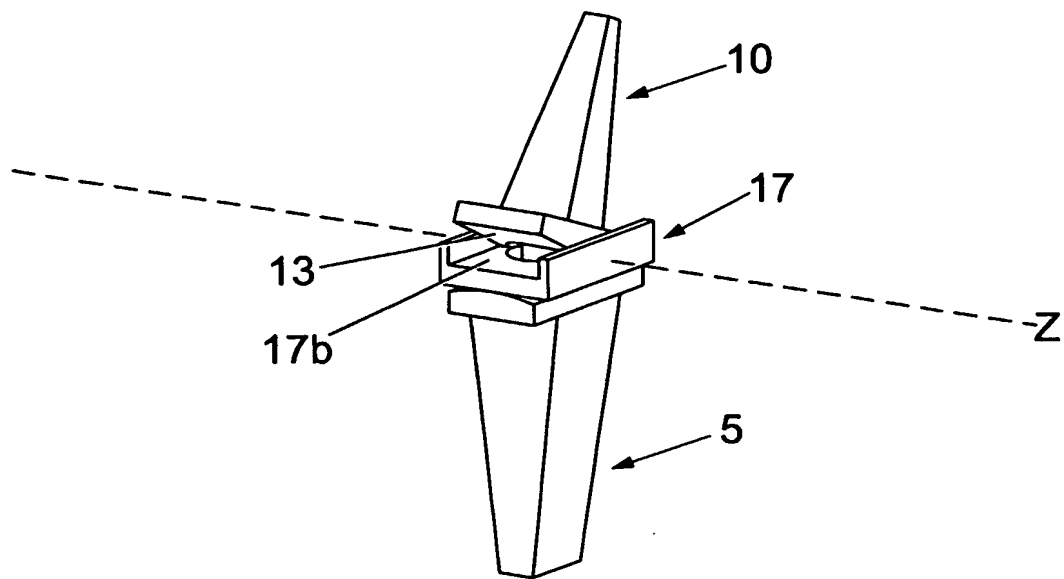
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*Fig. 12*

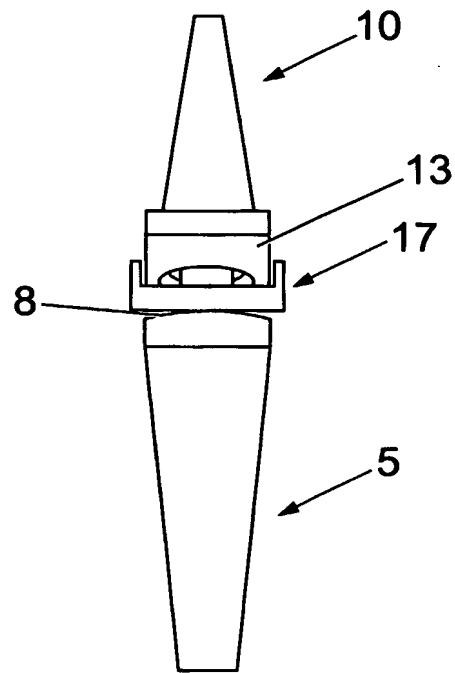


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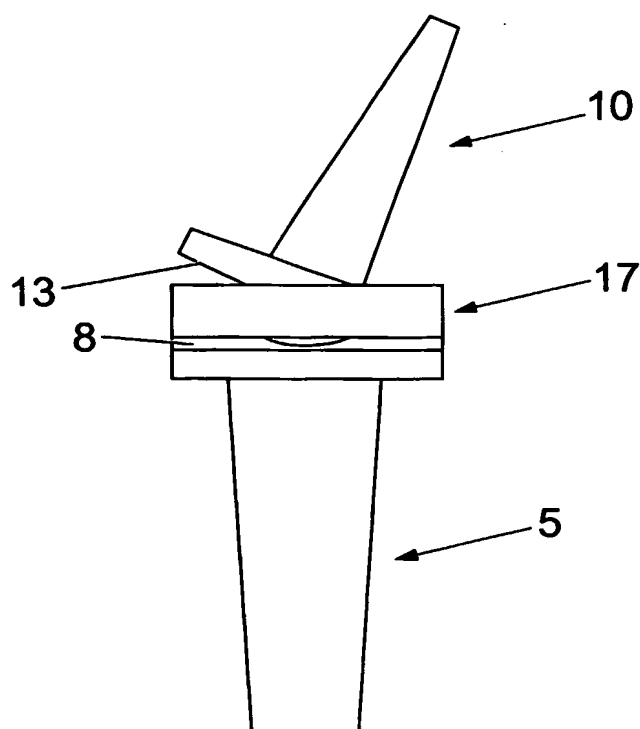
*Fig. 13*

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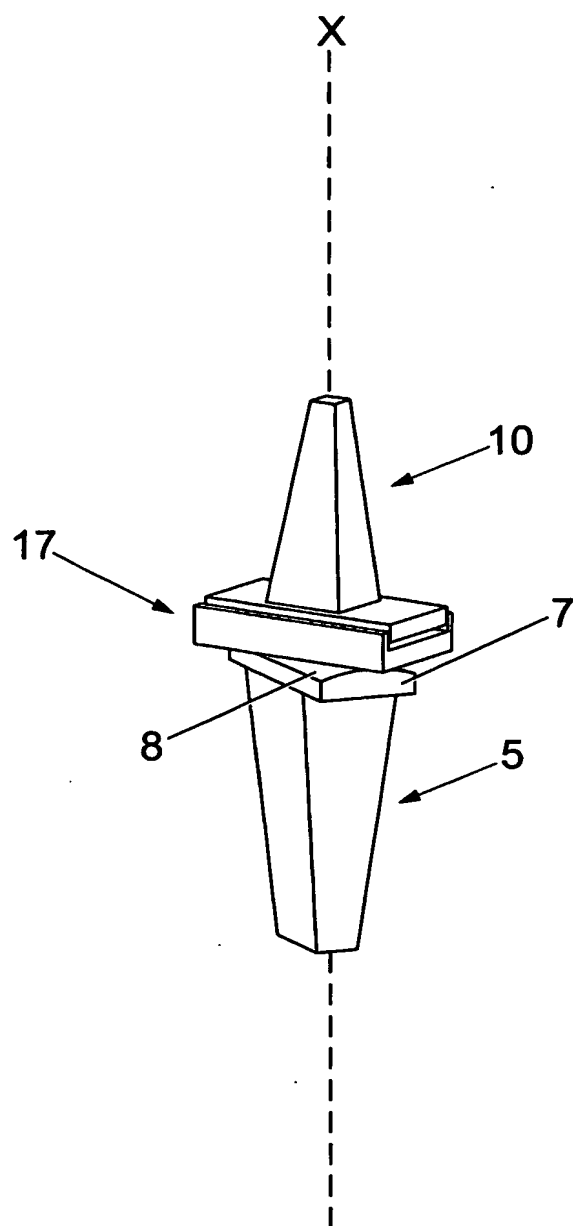
*Fig. 14*

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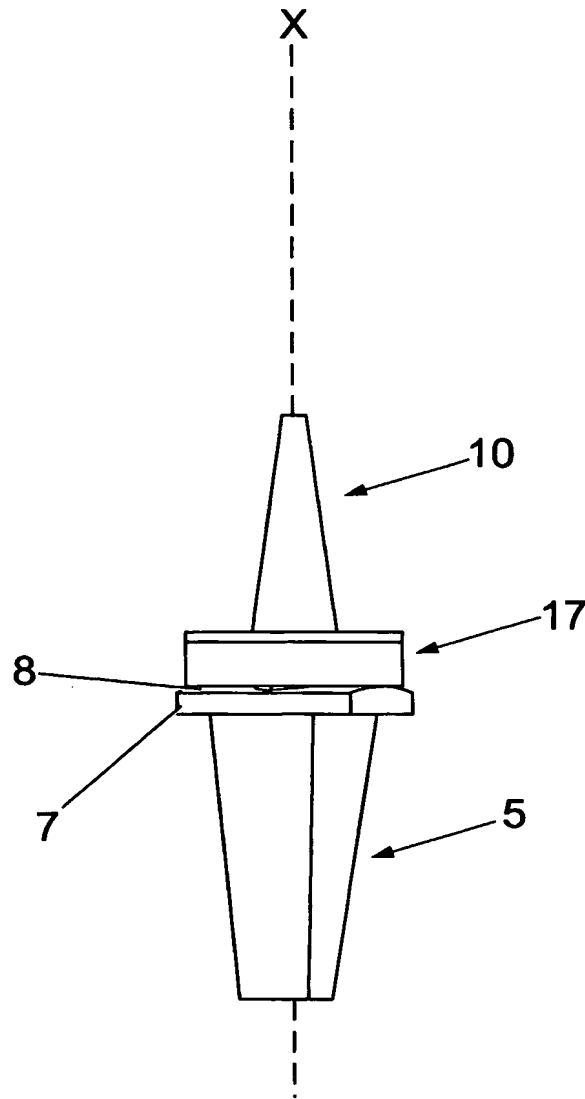
*Fig. 15*

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*Fig. 16*

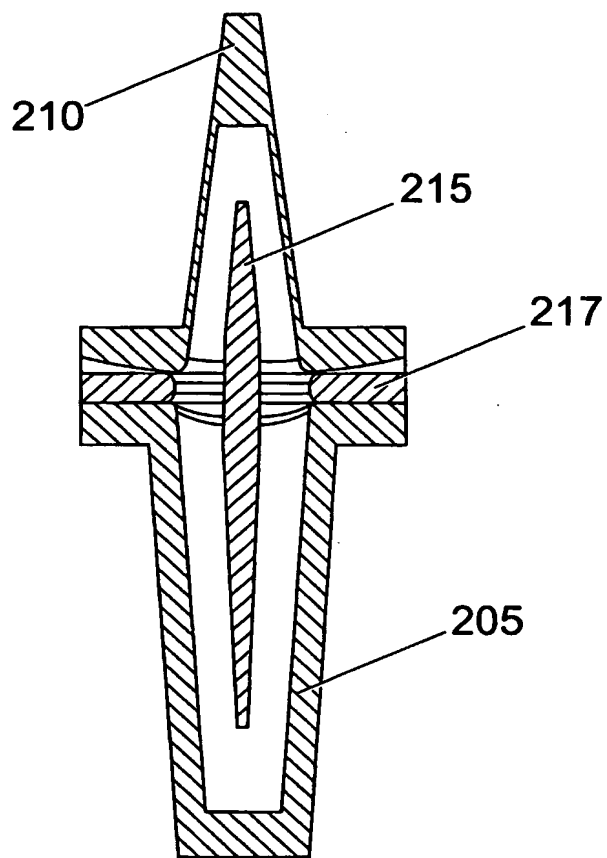
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*Fig. 17*

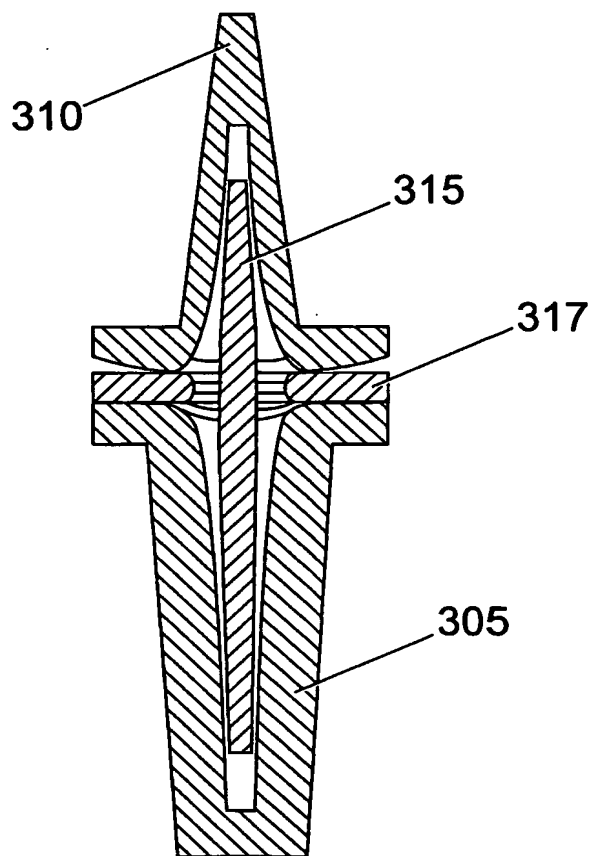


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*Fig. 19*

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*Fig. 20*



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